C1

"Hydrocarbons" are generally defined as molecules formed primarily by carbon and hydrogen atoms. Hydrocarbons may also include other elements, such as, but not limited to, halogens, metallic elements, nitrogen, oxygen, and/or sulfur.

On page 53, please delete the paragraph beginning on line 20, and substitute therefor:

C2

As shown in FIG. 3, in addition to heat sources 100, one or more production wells 104 will typically be disposed within the portion of the coal formation. Formation fluids may be produced through production well 104. Production well 104 may also include a heat source. In this manner, the formation fluids may be maintained at a selected temperature throughout production, thereby allowing more or all of the formation fluids to be produced as vapors. Therefore high temperature pumping of liquids from the production well may be reduced or substantially eliminated, which in turn decreases production costs. Providing heating at or through the production well tends to: (1) inhibit condensation and/or refluxing of production fluid when such production fluid is moving in the production well proximate to the overburden, (2) increase heat input into the formation, and/or (3) increase formation permeability at or proximate the production well.

In the Claims:

Please cancel claims 2620 and 2631 without prejudice.

Listed below is a clean copy of amended and new claims. A marked-up copy of the amended claims is provided in an accompanying document.

Sub E1

C3

~~2619.~~ (amended) A method of treating a coal formation in situ, comprising:

heating a part of the formation with heating elements, wherein at least two of the heating elements are placed in open wellbores, wherein at least one end of at least one of the heating elements is free to move axially within one of the open wellbores to allow for thermal expansion of the at least one heating element, and wherein superposition of heat from two of the heating

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C3

elements raises a temperature of the part between the two heating elements to a temperature within a pyrolysis temperature range in order to pyrolyze at least some hydrocarbons in the part of the formation.

Sub E1

2621. (amended) The method of claim ~~2619~~ 1, further comprising maintaining a temperature within a majority of the part within the pyrolysis temperature range during pyrolysis, and wherein the pyrolysis temperature range spans from about 250 °C to about 370 °C.

2622. (amended) The method of claim ~~2619~~ 1, wherein at least one of the heating elements comprises a pipe-in-pipe heater.

2623. (amended) The method of claim ~~2619~~ 1, wherein at least one of the heating elements comprises a flameless distributed combustor.

C4

2624. (amended) The method of claim ~~2619~~ 1, wherein at least one of the heating elements comprises a mineral insulated cable coupled to a support, and wherein the support is free to move within at least one of the wellbores.

2625. (amended) The method of claim ~~2619~~ 1, wherein at least one of the heating elements comprises a mineral insulated cable suspended from a wellhead.

2626. (amended) The method of claim ~~2619~~ 1, further comprising controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

Sub D1

2627. (amended) The method of claim 2619 further comprising controlling the heat such that an average heating rate of the heated part is less than about 1 °C per day in a pyrolysis temperature range of about 270 °C to about 400 °C.

2628. (amended) The method of claim ~~2619~~ 1, wherein heating the part of the formation further

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comprises:

heating a selected volume (V) of the coal formation from at least one of the heating elements, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day *(Pwr)* provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate *(h)* of the selected volume is about 10 °C/day.

10, 1
2629. (amended) The method of claim 2619, wherein heating the part of the formation comprises transferring heat substantially by conduction.

11 1
2630. (amended) The method of claim 2619, further comprising heating the part of the formation to increase a thermal conductivity of the part to greater than about 0.5 W/(m °C).

2642. (amended) The method of claim 2619, further comprising producing a mixture from the formation, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

25 1
2645. (amended) The method of claim 2619, further comprising controlling a pressure within the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute.

30 1
2650. (amended) The method of claim 2619, further comprising:

providing hydrogen (H_2) to the heated part to hydrogenate hydrocarbons within the heated part; and

heating a portion of the part with heat from hydrogenation.

31 1
2651. (amended) The method of claim 2619, further comprising:

producing hydrogen (H_2) and condensable hydrocarbons from the formation; and

hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen.

2652. (amended) The method of claim 2619, wherein heating increases a permeability of a majority of the heated part to greater than about 100 millidarcy.

2653. (amended) The method of claim 2619, wherein heating increases a permeability of a majority of the heated part, such that the permeability of the majority of the part of the formation is substantially uniform.

2655. (amended) The method of claim 2619, further comprising producing a mixture in a production well, and wherein at least about 7 heating elements are disposed in the formation for each production well.

2656. (amended) The method of claim 2619, further comprising providing heat from three or more heating elements to at least a portion of the formation, wherein three or more of the heating elements are located in the formation in a unit of heating elements, and wherein the unit of heating elements comprises a triangular pattern.

2657. (amended) The method of claim 2619, further comprising providing heat from three or more heating elements to at least a portion of the formation, wherein three or more of the heating elements are located in the formation in a unit of heating elements, wherein the unit of heating elements comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

5150. (new) The method of claim 2619, wherein heating the part of the formation comprises transferring heat from the heating elements substantially by radiation.

5151. (new) A method of treating a coal formation in situ, comprising:

heating a part of the formation with heating elements, wherein at least two of the heating elements are placed in open wellbores, wherein at least one end of at least one of the heating elements is free to move axially within one of the open wellbores to allow for thermal expansion of the at least one heating element, and wherein superposition of heat from at least two of the heating elements pyrolyzes at least some hydrocarbons in the part of the formation; and

producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°.

5152. (new) The method of claim 5150, wherein at least one of the heating elements comprises a pipe-in-pipe heater.

5153. (new) The method of claim 5150, wherein at least one of the heating elements comprises a flameless distributed combustor.

5154. (new) The method of claim 5150, wherein at least one of the heating elements comprises a mineral insulated cable coupled to a support, and wherein the support is free to move within the wellbore.

5155. (new) The method of claim 5150, wherein at least one of the heating elements comprises a mineral insulated cable suspended from a wellhead.

5156. (new) A method of treating a coal formation in situ, comprising:

heating a part of the formation with heating elements, wherein at least two of the heating elements are placed in open wellbores, wherein at least one end of at least one of the heating elements is free to move axially within one of the open wellbores to allow for thermal expansion of the at least one heating element, and wherein superposition of heat from at least two of the heating elements pyrolyzes at least some hydrocarbons in the part of the formation; and

controlling the pressure of a majority of the part of the formation at or above a 2 bar absolute.

Sub D3

5157. (new) The method of claim 5155, wherein at least one of the heating elements comprises a pipe-in-pipe heater.

C9

5158. (new) The method of claim 5155, wherein at least one of the heating elements comprises a flameless distributed combustor.

5159. (new) The method of claim 5155, wherein at least one of the heating elements comprises a mineral insulated cable coupled to a support, and wherein the support is free to move within the wellbore.

5160. (new) The method of claim 5155, wherein at least one of the heating elements comprises a mineral insulated cable suspended from a wellhead.

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Response To Office Action Mailed October 31, 2002

A. Pending Claims

Claims 2619, 2621-2630, 2632-2657, and 5150-5160 are currently pending. Claims 2619, 2621-2630, 2642, 2645, 2650-2653, and 2655-2657 have been amended. Claim 2620 and 2631 have been cancelled. Claims 5150-5160 are new.

B. Submission of Corrected Formal Drawings

In the Office Action mailed October 31, 2002, the Examiner indicated approval of the proposed drawing corrections filed on March 5, 2002. Applicant submits the corrected formal drawings approved by the Examiner (seven sheets, including FIGS. 23a, 23b, 32, 44, 54, 55, 59, 60, and 63).

C. Provisional Double Patenting Rejection

The Examiner provisionally rejected claims 2619-2657 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims of copending U.S. Patent Application Nos.:

09/840,936; 09/840,937; 09/841,000; 09/841,060; 09/841,061; 09/841,127; 09/841,128; 09/841,129; 09/841,130; 09/841,131; 09/841,170; 09/841,193; 09/841,194; 09/841,195; 09/841,238; 09/841,239; 09/841,240; 09/841,283; 09/841,284; 09/841,285; 09/841,286; 09/841,287; 09/841,288; 09/841,289; 09/841,290; 09/841,291; 09/841,292; 09/841,293; 09/841,294; 09/841,295; 09/841,296; 09/841,297; 09/841,298; 09/841,299; 09/841,300; 09/841,301; 09/841,302; 09/841,303; 09/841,304; 09/841,305; 09/841,306; 09/841,307; 09/841,308; 09/841,309; 09/841,310; 09/841,311; 09/841,312; 09/841,429; 09/841,430; 09/841,431; 09/841,432; 09/841,433; 09/841,434; 09/841,435; 09/841,436; 09/841,437; 09/841,438; 09/841,439; 09/841,440; 09/841,441; 09/841,442; 09/841,443; 09/841,444; 09/841,445; 09/841,446; 09/841,447; 09/841,448; 09/841,449, 09/841,488; 09/841,489; 09/841,490; 09/841,491; 09/841,492; 09/841,494; 09/841,495; 09/841,496; 09/841,497; 09/841,498; 09/841,499; 09/841,500; 09/841,501; 09/841,502; 09/841,632; 09/841,633;

09/841,634; 09/841,635; 09/841,636; 09/841,637; 09/841,638; and 09/841,639.

Applicant respectfully traverses the provisional double patenting rejection. Applicant respectfully submits that the omnibus nature of this rejection does not provide Applicant with sufficient detail in which to address such rejection. Applicant also respectfully submits that the rejection is also inconsistent with certain restrictions issued in the above-referenced cases. Applicant respectfully requests reconsideration.

Pursuant to a discussion in an Examiner interview on August 19, 2002, for the convenience of the Examiner, Applicant will forward copies of allowed claims for the above-referenced cases to the Examiner's Supervisor. Applicant understands that the Examiner's Supervisor will review the allowed claims for the above-referenced cases and then reconsider the double patenting rejection in view of such allowed claims.

D. <u>The Claims Are Not Obvious Over Bennett In View of Camacho or Hoyer Pursuant To 35 U.S.C. § 103(a)</u>

The Examiner rejected claims 2619 and 2621-2623 as unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 3,680,633 to Bennett (hereinafter "Bennett") in view of U.S. Patent No. 4,067,290 to Camacho et al. (hereinafter "Camacho") or U.S. Patent No. 4,091,869 to Hoyer (hereinafter "Hoyer"). Applicant respectfully disagrees with these rejections.

To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981 (CCPA 1974), MPEP § 2143.03.

Bennett appears to teach a method of treating a formation with an in situ combustion process that may include a downhole heater. Bennett states: "downhole heater 48 is not always essential in this process of initiating in situ combustion." (Bennett, col. 4, lines 25-26) Camacho describes "[a]n apparatus and method [that] utilizes a plasma arc torch as a heat source for

recovering useful fuel products from in situ deposits of coal, tar sands, oil shale, and the like." (Camacho, abstract, lines 1-2) Hoyer describes retorting a rubble pile by forcing "a hot gaseous media, which will liquefy or vaporize the hydrocarbon material...downwardly through the rubblized shale." (Hoyer, col. 3, lines 49-52)

Amended claim 2619 describes a combination of features including: "wherein superposition of heat from at least two of the heating elements raises a temperature of the part between the two heating elements to a temperature within a pyrolysis temperature range in order to pyrolyze at least some hydrocarbons in the part of the formation." Support for the feature "superposition of heat" can be found in the Specification on at least page 9, lines 6-14.

A method for achieving superposition of heat does not appear to be taught or suggested by Bennett, Camacho, or Hoyer. At least the above-quoted feature of claim 2619, in combination with other features of the claim, does not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejection of claim 2619 and the claims dependent thereon.

The Examiner states: "Bennett also teaches the pyrolysis temperature range as called for in claim 2621." Bennett states: "In order to prevent well damage due to excessive heat, heater temperatures should be maintained below approximately 800 °F." (Bennett, column 1, lines 63-65) Bennett appears to teach maintaining the heater temperature below about 800 °F (427 °C). Bennett does not appear to teach or suggest maintaining a part of the formation within a specified temperature range. The Examiner appears to be extending the teaching of Bennett. Amended claim 2621 describes a combination of features including: "maintaining a temperature within a majority of the part within the pyrolysis temperature range during pyrolysis, and wherein the pyrolysis temperature range spans from about 250 °C to about 370 °C." At least the above-quoted features of claim 2621, in combination with other features of the claim, do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejection of claim 2621.

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E. The Claims Are Not Obvious Over Van Meurs '118 In View of Van Meurs '715 and either Camacho or Hoyer Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2619-2621, 2624, 2625, 2627-2642, 2646, 2647, and 2652-2657 as unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 4,886,118 to Van Meurs et al. (hereinafter "Van Meurs '118") in view of U.S. Patent No. 4,570,715 to Van Meurs et al. (hereinafter "Van Meurs '715") and either Camacho or Hoyer. Applicant respectfully disagrees with these rejections.

The Examiner states:

> The 118 reference teaches a method of treating an oil shale formation including heating a selected section of the formation. The 118 reference fails to teach the end of the heater to move axially.
>
> The 715 reference teaches a similar method which includes a heater with an end free to move axially, in order to allow for thermal expansion.

Van Meurs '118 states: "In each heat-injecting well, substantially throughout the treatment interval, the well-surrounding face of the oil shale formation is sealed with a solid material and/or cement which is relatively heat conductive and substantially fluid impermeable." (Van Meurs '118, col. 4, lines 52-56) Van Meurs '715 states: "The so-constructed heater was cemented within an open borehole, using a commercially available heat resistant cement of a type designed for use in oil wells. The cement was expected to isolate the heating elements from contact with fluid flowing into or out of the surrounding earth formations." (Van Meurs '715, col. 4, lines 8-13)

Amended claim 2619 describes a combination of features including "wherein at least two of the heating elements are placed in open wellbores, wherein at least one end of at least one of the heating elements is free to move axially within one of the open wellbores to allow for thermal expansion of the at least one heating element". Support for the feature "open wellbores" may be found in the Specification at least on page 99, lines 23-25. The combination of Van Meurs with the other references appears to change the principle of operation of at least Van Meurs, and

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therefore is not sufficient to render the claims *prima facie* obvious. Applicant respectfully requests removal of the rejection of claim 2619 and claims dependent thereon.

The Examiner states: "The 715 reference also teaches the mineral insulated cable as called for in claim 2625, thus it would have been further obvious to one of ordinary skill in the art at the time of the invention to have the mineral insulated cable as called for in claim 2625."

Van Meurs '715 states: "the heating elements and supply cables are both spoolable cables and are coiled on spooling means for running elongated elements into a well." (Van Meurs '715, col. 2, line 68-col. 3, line 2) Van Meurs '715 further states: "the heater assembly consists of a pair of spoolable electric power supply cables 7 being run into the well from spools 8." (Van Meurs '715, col. 5, lines 22-24) Van Meurs '715 does not appear to teach or suggest suspending a heating element from a wellhead.

Amended claim 2625 describes a combination of features including: "wherein at least one of the heating elements comprises a mineral insulated cable suspended from a wellhead." At least the above-quoted features of claim 2625, in combination with other features of the claim, do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejection of claim 2625.

The Examiner states: "With regards to claim 2628; the 118 reference teaches the heating rate less than about 10 °C per day during pyrolysis (see col. 13, lines 15-18; 33 years divided by 300 °C is much less than 10 °C per day); the Pwr equation is nothing more than a standard thermodynamic relation."

Van Meurs '118 states: "The electrical injection rate is 3.23×10^6 BTU/well per day. The temperature of the injectors attains 750 °C. The production wells reach a terminal temperature of 300 °C. after 33-34 years of operation." (Van Meurs '118, col. 13, lines 13-17) Van Meurs '118 does not appear to teach or suggest using a desired heating rate to calculate a maximum amount of heating energy/day to be applied to a selected volume of a formation.

Amended claim 2628 describes a combination of features including: "heating a selected volume (V) of the coal formation from at least one of the heating elements, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation, and wherein heating energy/day *(Pwr)* provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate *(h)* of the selected volume is about 10 °C/day." At least the above-quoted features of claim 2628, in combination with other features of the claim, do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejection of claim 2628.

The Examiner states: "With regards to claims 2631-2642, 2646, 2647; the nature of the hydrocarbons produced from such heating is highly variable, and dependent upon many factors, not least of which is the characteristics of the formation. The components of the produced mixture are deemed to be inherent results of design variables, including formation characteristics." Applicant respectfully disagrees with these rejections.

The product mixtures recited in claims 2631-2642, 2646, 2647 may be produced by controlling and/or modifying formation conditions during treatment to produce the selected results recited in the claims. The product mixtures recited in claims 2631-2642, 2646, 2647 do not appear to be producible by carrying out the heating process of the cited art. In relying upon the theory of inherency, the Examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art. *Ex parte Levy,* 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990). Applicant respectfully requests that the Examiner provide support that the above-mentioned feature is inherent to the cited art. Otherwise the Applicant requests that the rejection of the claims be removed.

The Examiner states: "With regards to claims 2652 and 2653; the increase of permeability is an inherent result of the Van Meurs process." Applicant respectfully disagrees

that the features of claims 2652 and 2653 are inherent results of the Van Meurs process.

Van Meurs '118 states:

> Applicants discovered that when a substantially impermeable subterranean oil shale having the presently specified combination of grade and thickness was conductively heated as presently specified, a zone of permeability was developed between wells within the oil shale. Although the present invention is not premised on any particular mechanism, in the course of such a treatment the heated oil shale behaved as though it was subjected to a process for thermally inducing the formation of horizontal fractures. Such a behavior was not predictable, since the present process is operated without any injection of any fluid. (Van Meurs '118, col. 15, lines 32-43)

Van Meurs does not appear to specify the permeability of the "zone of permeability" that is developed. Applicant submits that increasing the permeability of a part of the formation to a particular value is not inherent to the process of Van Meurs '118.

Amended claim 2652 describes a combination of features including: "wherein allowing the heat to transfer increases a permeability of a majority of the part of the formation to greater than about 100 millidarcy." Amended claim 2653 describes a combination of features including: "wherein heating increases a permeability of a majority of the part of the heated part, such that the permeability of the majority of the part of the formation is substantially uniform." At least the above-quoted features, in combination with other features of the claims, do not appear to be taught or suggested by the prior art. Applicant respectfully requests removal of the rejection of claims 2652 and 2653.

F. The Claims Are Not Obvious Over Van Meurs '118 and Van Meurs '715 and Camancho or Hoyer In View of Stoddard Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2643 and 2644 as unpatentable under 35 U.S.C. § 103(a) over Van Meurs '118 and Van Meurs '715 and Camacho or Hoyer, as applied to claim 2619 above, in view of U.S. Patent Application No. 4,463,807 to Stoddard et al. (hereinafter "Stoddard"). The Examiner states: "It would have been obvious to one of ordinary skill in the

art at the time of the invention to have practiced the method of the 118 reference, as modified, in a formation with characteristics allowing greater than 0.05% of the produced mixture to be ammonia, as called for in claim 2643." Applicant respectfully disagrees with these rejections.

With reference to ammonia, Stoddard appears to state only: "A seal against water incursion serves two purposes: water is excluded from the georeactor and the processes underway, and water soluble products of reactions (phenols, ammonia and the like) are excluded from the aquifer." (Stoddard, col. 3, lines 28-32) Stoddard does not appear to teach or suggest ammonia as a component of a produced mixture. Furthermore, Stoddard does not appear to teach or suggest a particular weight percentage of ammonia in a produced mixture. Nor does Stoddard does appear to teach or suggest a use for ammonia (e.g., fertilizer) in a produced mixture.

Claim 2643 describes features including: "producing a mixture from the formation, wherein the produced mixture comprises ammonia, and wherein greater than about 0.05% by weight of the produced mixture is ammonia." The product mixture recited in claim 2643 may be produced by controlling and/or modifying formation conditions during treatment to produce the selected results recited in the claim. Applicant submits that the product mixture recited in claim 2643 would not be producible by carrying out the heating process of the cited art. Claim 2644 describes features including: "producing a mixture from the formation, wherein the produced mixture comprises ammonia, and wherein the ammonia is used to produce fertilizer." The above-quoted features of claims 2643 and 2644, in combination with other features of the claims, do not appear to be taught or suggested by the prior art. Applicant respectfully requests removal of the rejections of claim 2643 and 2644.

G. The Claims Are Not Obvious Over Van Meurs '118 and Van Meurs '715 and Camancho or Hoyer In View of Elkins Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2626 and 2645 as unpatentable under 35 U.S.C. § 103(a) over Van Meurs '118 and Van Meurs '715 and Camacho or Hoyer, as applied to claim 2619

above, in view of U.S. Patent Application No. 2,734,579 to Elkins et al. (hereinafter "Elkins"). Applicant respectfully disagrees with these rejections.

The Examiner states:

> It would have been obvious to one of ordinary skill in the art at the time of the invention to have further modified the process of the 118 reference to have included the pressure greater than 2 bar as called for in claim [2645], or to have included the temperature is controlled as a function of the pressure or the pressure is controlled as a function of the temperature as called for in claim [2626], and as taught by Elkins, in order to prevent overheating.

Van Meurs '118 states:

> The present invention relates to a process for conductively heating a subterranean oil shale formation in a manner arranged for producing oil from a subterranean oil shale formation which is, initially, substantially impermeable. In accordance with this invention, the portion of oil shale deposit to be treated is selected, on the basis of the variations with depth in the composition and properties of its components, to have properties capable of interacting in a manner which at least maintains the uniformity of the heat fronts and preferably enhances the uniformity of the heat fronts to an extent limiting the time and energy expenditures for producing the oil to values less than the value of the oil which is produced. (Van Meurs, column 3, lines 31-43)

Elkins states:

> It is important to control the temperature within the reaction zone. I have found that the minimum temperature of this zone at which combustion normally can be maintained is of the order of approximately 400° F. It is desirable to maintain the temperature higher than this value up to temperatures from 800° F. to 1000° F. When the temperature rises substantially higher than these values, roughly above 1,200° F., combustion takes place too rapidly, the recoverable cracked products are minimized, the liquefaction occurs considerably ahead of the combustion zone, and, in general, the loss of valuable petroleum products in the combustion itself will become sufficiently great to make the process a good deal less economical. Control of the temperature within the reaction zone can be maintained in several ways. The increase in volume of oxygen-containing gas by application of higher injection gas pressure will increase this temperature. The higher temperature is maintained primarily by the fact that the time available for the loss of sensible heat to the formations adjacent and downstream from the combustion zone is minimized. In addition, the higher rate of injection and the increased supply of

> oxygen at the reaction zone by virtue of the higher pressures consumes additional oil in combustion above that required at lower rates and thereby generates more heat. To keep the temperature from becoming too high, it is possible to dilute the air with inert gas, for example, by separating the inter gaseous products of combustion (principally oxides of nitrogen and carbon) from the produced hydrocarbons, and introducing it into the injection stream. This slows down the rate of heat generated and provides additional time for sensible heat loss to adjacent formation as well as to the formation itself in front beyond the combustion zone. Decreasing the injection gas pressure also decreases the combustion zone temperature. (Elkins, column 3, lines 13-46)

If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious. *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959), MPEP § 2143.01.

Van Meurs '118 appears to teach or suggest conductively heating an oil shale formation to produce oil from the formation. Elkins appears to teach or suggest the injection of air to maintain combustion within a formation and to maintain a temperature between approximately 400° F and 1000° F. Elkins further appears to teach or suggest decreasing the injection gas pressure to decrease the combustion zone temperature when the temperature rises above 1200° F. Applicant submits that combination of the prior art would change the principle of operation of the prior art invention being modified.

Elkins does not appear to teach or suggest features of amended claim 2626, including "controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure." Furthermore, Elkins does not appear to teach or suggest features of amended claim 2645, including: "controlling a pressure within the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute." At least the above-quoted features of claims 2626 and 2645, in combination with other features of the claims, do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of these rejections.

H. The Claims Are Not Obvious Over Van Meurs '118 and Van Meurs '715 and Camancho or Hoyer In View of Gregoli Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2648-2651 as unpatentable under 35 U.S.C. § 103(a) over Van Meurs '118 and Van Meurs '715 and Camacho or Hoyer, as applied to claim 2619 above, in view of U.S. Patent Application No. 6,016,867 to Gregoli et al. (hereinafter "Gregoli"). Applicant respectfully disagrees with these rejections.

The Examiner states:

> The 118 reference fails to teach the altering pressure to inhibit production of hydrocarbons having carbon numbers greater than 25. The Gregoli reference teaches that in a similar in-situ processes, it is beneficial to use high pressure to break heavy hydrocarbons. It is well known that carbons having carbon numbers greater than about 25 are considered to be heavy; and impede production because they are dense and viscous. It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the method of the 118 reference to have included altering pressure to inhibit production of hydrocarbons having carbon numbers greater than about 2, as called for in claim 2648 in order to improve production.
>
> The 118 reference fails to teach the recirculating hydrogen, providing hydrogen, or hydrogenating. The Gregoli reference teaches that in a similar in-situ processes, it is beneficial to use hydrogen to hydrogenate heavy hydrocarbons.... It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the 118 method to have included recirculating hydrogen as called for in claim 2649; providing hydrogen as called for in claim 2650; and hydrogenating as called for in claim 2651; in order to reduce the heavy hydrocarbons and to improve production.

Gregoli states:

> A process is disclosed for the in situ conversion and recovery of heavy crude oils and natural bitumens from subsurface formations using either a continuous operation with one or more injection and production boreholes, which may include horizontal boreholes, or a cyclic operation whereby both injection and production occur in the same boreholes. A mixture of reducing gases, oxidizing gases, and steam are fed to downhole combustion devices located in the injection boreholes. Combustion of the reducing gas-oxidizing gas mixture is carried out to produce superheated steam and hot reducing gases for injection into the formation to convert and upgrade the heavy crude or bitumen into lighter hydrocarbons. (Gregoli, Abstract)

As described in Section G, Van Meurs appears to teach or suggest conductively heating an oil shale formation to produce oil from the formation. Gregoli appears to teach or suggest injecting reducing gases, oxidizing gases, and steam into injection boreholes in a formation. Combustion of the gas mixture produces super-heated steam, which heats the formation. The heat converts and upgrades hydrocarbons in the formation. Applicant submits that combination of the prior art would change the principle of operation of the prior art invention being modified. Applicant therefore requests removal of the obviousness rejection of claims 2648-2651.

I. The New Claims Are Not Anticipated or Obvious In View of the Cited Art

Applicant submits that new claims 5150-5160 are supported by the specification as originally filed and do not read on the cited prior art. Claim 5150 is supported in the specification at least at page 8, lines 1-7.

J. Conclusion

Applicant submits that all claims are in condition for allowance. Favorable reconsideration is respectfully requested.

A Fee Authorization is enclosed to cover fees for additional claims and a one-month extension of time. If further extension of time is required, Applicant hereby requests the appropriate extension of time. If any additional fees are required or if fees have been overpaid, please appropriately charge or credit those fees to Meyertons, Hood, Kivlin, Kowert & Goetzel, P.C. Deposit Account Number 50-1505/5659-06500/EBM.

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Respectfully submitted,

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